



Progress on Technical Components

Cal Tech Jan 2002
Jan 5, 02
B. Baller
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- Technical Progress
 - BSPAG issues



Progress

● Extraction & Primary Beam (WBS 1.1.1) (Sam Childress & **Craig Moore**)

→ Beam transport original design based on Main Injector multi-batch emittance and $\delta p/p$ design specifications

◆ **Concern raised in summer reviews: MI operates in single batch mode now. Design values not confirmed by measurements.**

◆ **Peter Lucas will present his recent work to reduce sensitivity to $\delta p/p$**

◆ **Alberto Marchionni will present results on MI/P150 measurements**

→ Kicker magnet issues

◆ **Ceramic beam tubes (2 long tubes needed) – no supplier**

– BD investigating glass tubes – larger aperture, better mechanical connection to vacuum flange, **more fragile than ceramic, radiation resistance uncertain**

– Recovered 3 long ceramic tubes from surplus Tevatron kickers – vacuum testing in process

– Decision on kicker configuration (2 or 3) in January

◆ **Dielectric oil (Flourinert) dissociates into HF acid and “nerve gas”**

– BD installed temporary scrubbing system on existing kickers

◆ **Flourinert cooling system needed for NuMI**

– Cooling system conceptual design complete – incorporates scrubbing system



Progress

● Extraction & Primary Beam (WBS 1.1.1) - Continued

→ Beam Position Monitor (BPM)

- ◆ PPD electronics engineer & Valeri Makeev working on new electronics to replace circa 1980 electronics
- ◆ Prototype has been bench tested and recently tested in 8 GeV transfer line
- ◆ MiniBoone is the first customer

→ Beam Extraction Permit System

- ◆ Prototype system developed by Bob Ducar will be tested in P150 in January

● Neutrino Beam Devices (WBS 1.1.2)

→ First horn module out for bid Nov 15 (URA milestone)

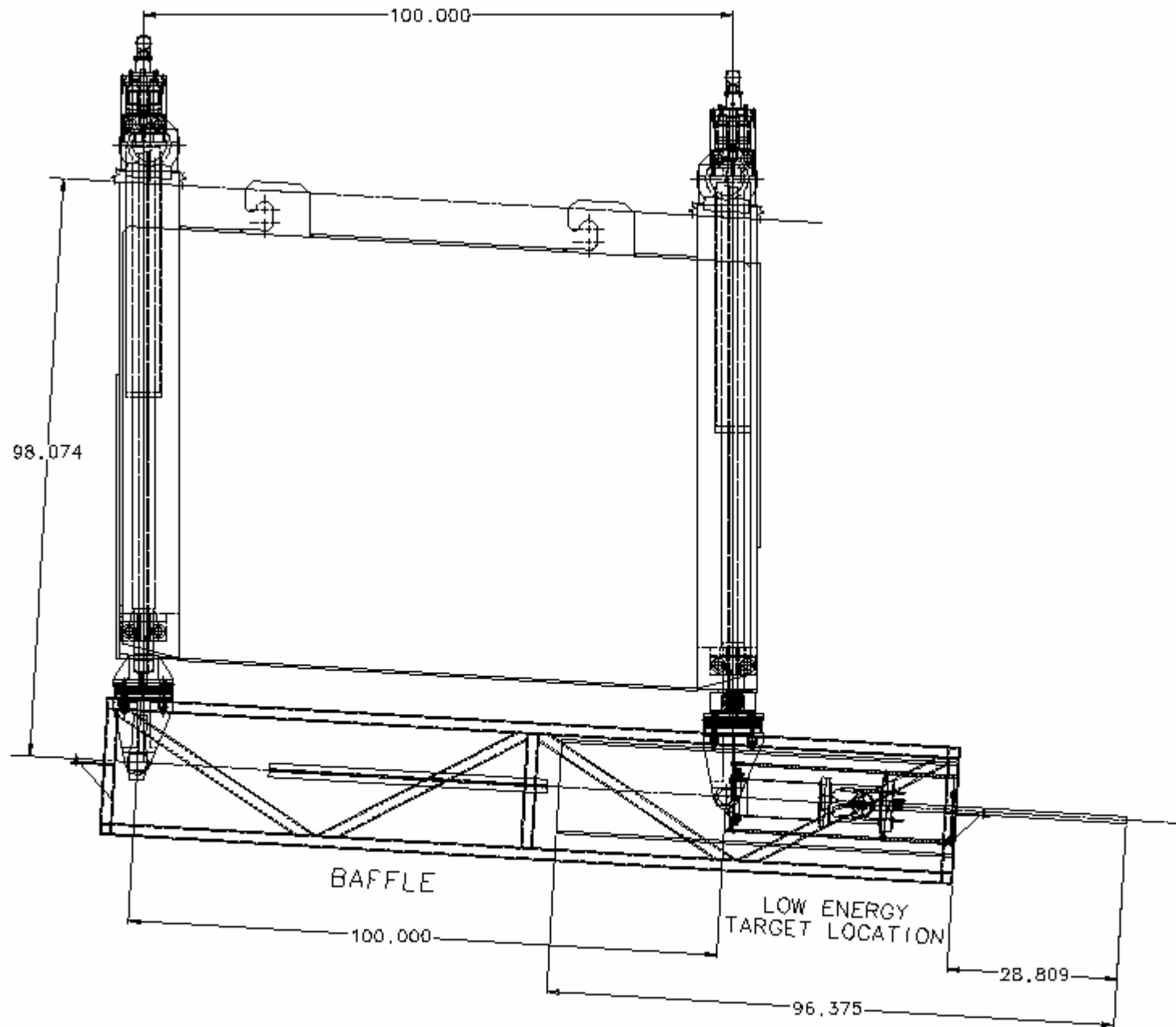
→ Horn 1 & 2 outer conductor forgings received

→ Inner conductor welding in early spring

→ LE target drawings (IHEP) await final review

- ◆ 47 - 6.4 mm x 18 mm vertical graphite segments
- ◆ 1 - 6.4 mm x 18 mm horizontal segment for vertical alignment
 - Horizontal segment recently studied in GNUMI – OK
- ◆ Plan to accept LE target design with horizontal segment







Progress

● Neutrino Beam Devices (WBS 1.1.2) – Continued

- Bob Bernstein will start work on LE target/baffle support in January
- Dave Ayres, Rich Talaga & Bob Wagner working on target hall instrumentation and horn testing
- Target chase shielding design complete – in drafting
- Chase cooling system pressure drop calculations checked

● Power Supply Systems (WBS 1.1.3)

- 1.8M pulses on the prototype horn at MI8
 - ◆ Charging power supply SCR's failed – replaced with higher rating
 - ◆ Regular horn testing will cease in January due to limited manpower
- Horn 1 flexible joint and Horn 2 solid joint drawings are complete
 - ◆ Slit & clamp design changed slightly to reduce stresses
 - ◆ Flex joint will be procured and mechanically tested
- Recent focus on integration of stripline, flex joint & clamp with horn 1 module (WBS 1.1.2)



NUMI FLEXJOINT
END VIEW LAYOUT
FERMI DWG. NO.



PRELIMINARY
7-5-2001



Progress

● Hadron Decay & Absorber (WBS 1.1.4)

→ Hadron Absorber review Nov 20

◆ All issues raised at previous review were addressed

→ Downstream access port was removed & absorber moved 2m upstream

◆ Minimizes the lightly shielded region between absorber and DK pipe

◆ Raises the beam on the absorber so shower-max is centered in absorber

→ Upstream decay pipe end cap design on hold – BSPAG issue

● Neutrino Beam Monitoring (WBS 1.1.5)

→ Review of muon and downstream hadron monitoring systems Dec 10

◆ Pad Ionization Chamber design meets requirements for muon monitors

– Engineering design should proceed

◆ PIC meets the base downstream hadron monitor (DHM) scope

– Beam pointing to Soudan during low intensity commissioning

◆ It is desirable for the DHM to function in-situ for ~1 year

– DHM + semi-ME beam provides information on pointing

– Radiation hardness, neutron backgrounds not well understood



Progress

- **Survey & Alignment (WBS 1.1.6)**
 - Focus of activity is civil construction quality assurance
 - Developed methods for surveying (hot) horns in target chase
- **Utilities & Integration (WBS 1.1.7)**
 - All Process & Instrumentation Diagrams done
 - 1500 kVA pulsed power transformer installed at MI-60 North



BSPAG– Semi Beams

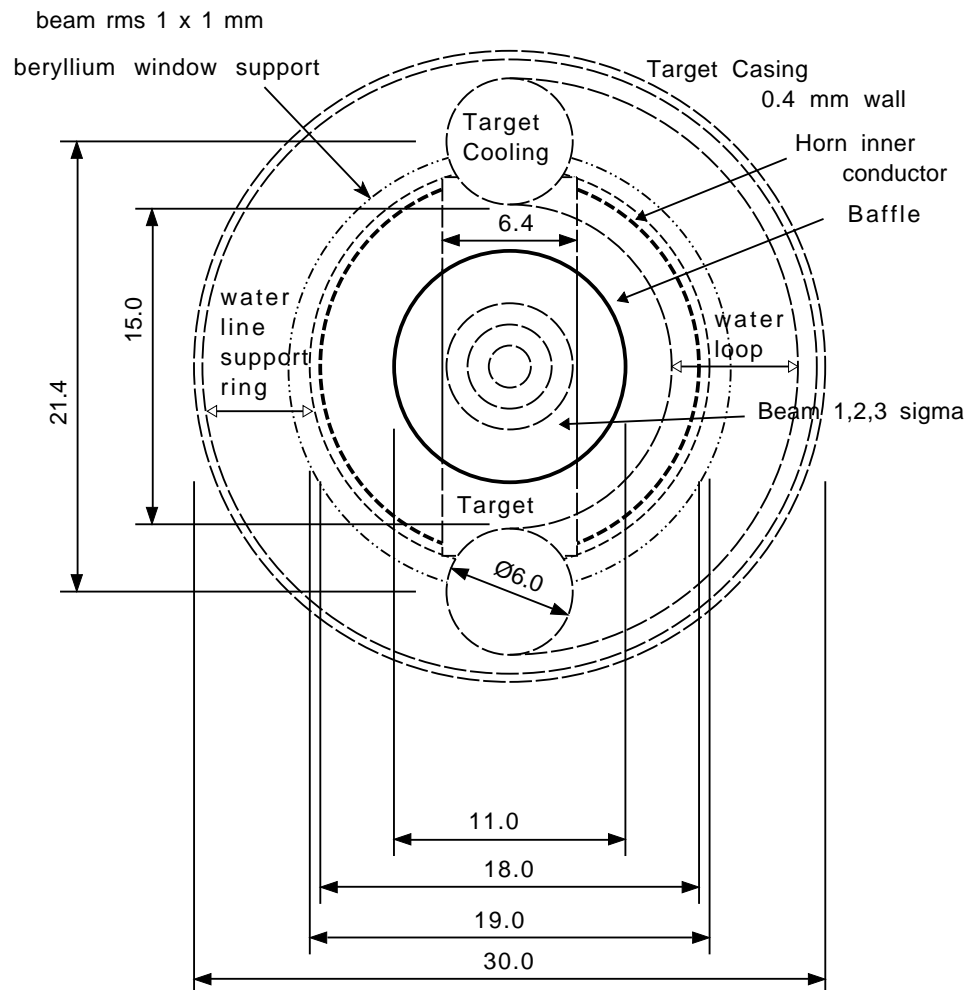
- **Semi-ME/LE beams (NuMI-B-783) are not in the baseline**
 - LE target support must provide ~70 cm travel for insertion into horn
 - ◆ **Included in baseline design**
- **Semi-ME beam ($z < -2$ m. Flux ~ 80% ME beam)**
 - Longer water, vacuum, control lines
 - Cooling needed for downstream end of target/baffle module?
 - Target + baffle alignment to horn 1
 - ◆ **Need to know required target alignment tolerance at various z positions**
 - **Moderate risk: Motion control in high radiation environment**
 - Additional cost ~\$200k (burdened), no schedule impact
- **Semi-HE beam ($z \sim -4$ m)**
 - Large cantilever significantly complicates module design
 - Significantly complicates hot cell design
 - This option will not be considered further
- **Target support design will start in January**
 - **We will work on the assumption that a Semi-ME beam is desired with minimum $z \sim -2.7$ m**



BSPAG – Baffle Configuration

- **Baffle will be mounted on the target module**
 - Separate baffle module costs ~\$250k + significant engineering effort
- **Baffle aperture**
 - Baseline requirement – protect horn inner conductor
 - Rectangular aperture (5.4 mm x 12 mm)
 - ◆ Completely shadows primary beam – protected hose wire
 - ◆ Beam tails create high energy tail
 - ◆ Protects(?) decay pipe window with new smaller divergence primary beam
 - Circular aperture (5.5 mm radius)
 - ◆ Eliminates HE tail
 - Aperture choice does not impact cost or schedule
- **Baffle length**
 - 1.2 m long graphite baffle protects the horn
 - A shorter baffle allows larger target movement for Semi beams
 - ◆ Mixed media baffle? (graphite + nickel sandwich)
 - ◆ Requires MARS & thermal analysis = Physicist + engineering effort
 - ◆ Need a decision in next 2 months

Circular Baffle





BSPAG – Decay Pipe Extension

- **Baseline window is 2 m diameter (3/16” steel ellipsoidal window)**
- **Proposal to extend decay pipe to LE/ME position (NuMI-B-777)**
 - Decay pipe extension diameter ~1.1 m (window thickness = 1.2 mm steel)
 - Extension to LE position gains 13% with a loss of flexibility
 - Extension to ME position gains 7% with less loss of flexibility
- **Impact of extending the pipe from project viewpoint**
 - Beam heating on window acceptable? Temperature must be $< 600^{\circ}\text{F}$
 - Re-design of decay pipe window
 - ◆ **4-6 months of engineering**
 - Target chase “ceiling” needs to be raised 6”
 - ◆ **1 month of engineering**
 - M&S costs slightly higher
 - Cost ~\$150k (burdened)
 - No schedule impact



BSPAG – Alignment wires

- **Alignment wires 1 mm x 3 mm on horns (A. Para - NuMI-B-796)**
 - Cross-hair configuration on both(?) horns
 - Temporary beam loss monitor (BLM) installed in target chase
 - ◆ **Install access port(s) in top shield blocks**
 - Move target/baffle out of beam during commissioning
 - Scan low intensity beam & horn 1 to maximize signal in BLM
 - Expected alignment precision ~ 200 microns
 - Option: eliminate wires on horn 1. Scan beam on inner conductor
- **Proposal reviewed by project staff and BSPAG**
- **Cost ~\$50k**
- **We propose to adopt the wires into the baseline design**



Cost & Schedule Update

Report Date: Oct 31, 2001

Base + esc + indirect (K\$)

WBS	BCWS	BCWP		ACWP		Variance	
		reported	accrual	reported	accrual	Schedule	Cost
1.1.1	1,348	1,295		1,461		(53)	(166)
1.1.2	3,906	3,621	100	3,558		(185)	163
1.1.3	2,289	2,235		2,465		(54)	(230)
1.1.4	343	355	-	352		12	3
1.1.5	152	152	-	80	-	-	72
1.1.6	157	178		143		21	35
1.1.7	391	391		436		-	(45)
1.1.8	533	542	-	423		9	119
Total	9,119	8,769	100	8,918	-	(250)	(49)

Schedule variance mostly due to accounting methods





Summary

- **Significant improvement in beam transport – more study required**
- **Horn and module work on schedule**
- **Flex joint design complete!**
 - Significant progress since May
- **Hadron Absorber design complete!**
- **PIC design accepted for muon monitoring system!**
 - Excellent effort by the monitoring group
- **PIC appears to meet basic commissioning scope of the DHM**
 - “Plug n Play” DHM – leave DHM in until it dies, plan for easy replacement
- **BSPAG issues**
 - Semi beam – Include in baseline design
 - Baffle length – Need a decision in 2 months
 - Baffle aperture – Need a decision in 6 months
 - Decay pipe extension – Need a decision in 3 months